Mapping the Green Building Industry: How Local are Architects and General Contractors?

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Abstract: This paper is an empirical analysis of the geography of the green building economy within the United States, based on the location of the architects and contractors involved in producing green buildings in a selection of metropolitan areas. An overwhelming percentage of both architects and contractors are locally-based, suggesting that rather than green building expertise clustering in a few cities, it has diffused nationwide. This has positive implications for the spread of knowledge about how to build more sustainably and also suggests that economic geographers need to broaden their study of the architecture industry beyond iconic buildings in world cities.

Keywords: green buildings, LEED, spatial distribution, architects, contractors, economic geography

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INTRODUCTION

Green buildings, as defined by standards and rating systems such as the Leadership in Energy and Environmental Design (LEED) program of the U.S. Green Building Council (USGBC), have been growing at a rapid rate since the year 2000. Designed to reduce the consumption of water, energy, and materials, as well as the production of stormwater runoff, construction waste, and chemical and carbon emissions, these buildings are constructed under voluntary, flexible, third-party standards. Such standards rely explicitly on geographical criteria, including the suitability of specific sites, the use of local materials, and the regional climate, to define what is "green" and where green construction should occur. While there are multiple rating systems in the United States and abroad, such as the Green Globes, Energy Star, and Green Star, the dominant system in the U.S. is the USGBC's LEED.

The emerging green building economy is a combination of multiple economic sectors that already have their own spatial patterns: architecture, engineering, construction management, etc. While every building must be designed with consideration of its physical environment, this is even more true for green buildings, where physical characteristics such as climate, local materials, and transportation infrastructure play a vital role. At the same time, knowledge of existing regulations and ways of doing business are also more important because of extra requirements or incentives that may have to be negotiated, as well as potential conflicts with existing building codes and regulations at multiple scales. The LEED standards comprise a body of global knowledge that must be combined with multi-scalar knowledges such as regional

physical conditions and local, state, and federal regulatory environments to produce a certified green building. It is therefore important to know whether the people and firms involved in producing green buildings are likely to need to acquire this knowledge of local conditions in order to combine it with the LEED rating system. For example, are there experts on the general methods of green building in architect-rich places such as Chicago or San Francisco who apply general knowledge about green building to local, context-specific projects in Atlanta or Albuquerque, or are local architects and contractors based in these smaller cities learning the LEED rating system and integrating it with their own existing knowledge of local conditions?

This is an important question because buildings contribute to economic development in terms of construction jobs and potentially via professional services. I say potentially, because unlike construction workers who must be on site to complete a project, there is no requirement that architects be in the same city as the buildings they design. In fact, this is increasingly not the case (Faulconbridge 2009), although within the U.S., there must be an architect on the project team who is licensed to practice within the state. In order to determine the economic impact of third-party standards such as LEED, it is therefore necessary to know the spatial distribution of the industries in question: are the economic benefits associated with building to third-party standards accruing in the localities where they are built, or are the designers and their expertise located elsewhere? At the same time, economic geographers' work on the architecture industry has concentrated on iconic buildings in world cities, not the production of more mundane structures such as schools and fire stations. This paper contributes to this literature by

demonstrating that there is a different geography of architectural production when considering these more common but less iconic structures.

To answer these questions, this paper identifies firms associated with the 526 green buildings built between 2000 and 2010 in eight metropolitan areas: Albuquerque, Atlanta, San Francisco-Oakland-San Jose, Chicago, Dallas-Ft. Worth, Grand Rapids, MI, Minneapolis-St. Paul, and Philadelphia. These metropolitan regions were chosen for their diversity in terms of region, size, and relative level of green building activity. The firms' local offices and headquarters were then identified to determine how much of a local presence they have in the cities where they are building. The paper focuses on two groups of actors—architects and general contractors—as contributing specific skills for the production of a green building. A traditional building process has the architect as the lead actor, with engineers subcontracted to the architect to verify the structural, mechanical, and other elements of the design. The general contractor generally has a separate contract with the building's owner (except in design-build arrangements). Studies have shown that projects attempting LEED certification rely more heavily on successful communication among architects, engineers, and contractors throughout the design and construction process, often incorporating feedback at multiple stages or ensuring all of the project team members meet frequently throughout the project in a circular process. In part, this is due to the complex nature of LEED standards: many credits are related to the design of the building or the choice of site, but many have to do with internal building systems, and some are based on construction practices such as waste reduction. Additionally, changes may need to be made by the engineer or contractor that will affect the overall design,

and so closer contact among all parties is essential. However, because engineers are generally subcontracted to the architect, information on these firms is more difficult to find, and so the location of engineers is not considered in this paper[1].

In studying the spatial distribution of green building activity through architects and contractors, this paper contributes to two main bodies of literature: third-party standards and their contribution to economic activity, and the spatial nature of (green) architecture. The next two sections summarize these bodies of work and highlight the gaps which this study partially fills. This is followed by more information on the LEED rating system and the methods used in this study. The empirical results of the analysis demonstrate the strong local nature of the green building economy, suggesting that the LEED standards are, in fact, traveling from place to place rather than clusters of green expertise forming in particular cities or regions. The conclusion offers some explanations for the empirical findings and suggestions for future research.

THIRD-PARTY STANDARDS AND ECONOMIC GOVERNANCE

The shift from government to governance has been studied by geographers, sociologists, political scientists, and others for over a decade, meaning the shift from state government to a more complicated arrangement of public, private, and non-profit sector interests, in many cases devolving responsibility down to the individual. On example of this is the shift from state regulation to third-party standards or certification processes (Callon 2007). Here, I define governance as "the framework and institutional structures by which rules (which include laws

[1] We did gather subcontractor data for one of our sample cities, Chicago, and found no difference in the percentage of subcontracted engineers that are locally-based as compared to architects or general contractors.

at one extreme and norms at the other) are set and implemented" (Nadvi 2008, p. 324). These standards are found in food, forestry, and a variety of other economic sectors, some focused on the processes by which a product is made, others on labor or environmental conditions, others on the qualities of the finished product. What they have in common is a more complicated system of determining where quality lies, enrolling actors from public, private, and non-profit sectors (Eden 2009, Hatanaka and Busch 2008) as they attempt to change economic practices through market pressures rather than direct regulation, commonly in a multi-stage process of defining standards, auditing producers, and labeling products (Gulbrandsen 2005, Klooster 2010). In other words, instead of implementing quality or other standards by regulatory fiat, producers and consumers have to be persuaded to adopt these standards. Forest certification is the most well-developed, both in terms of the number of standards schemes and the amount of writings about them (Auld et al. 2008, Gulbrandsen 2005, Klooster 2010, McDermott et al. 2008). Other commodities with well-developed standards include fisheries, tourism, coffee (Bitzer et al. 2008,Giovannucci and Ponte 2005) and organic foods (Schewe 2011).

On the one hand, regulatory success has *always* depended on enrolling multiple actors into the process, including those who craft regulations, those who enforce their compliance, and those who do the complying (Bennett 2000). The difference with the recent trend towards standards in multiple arenas is making the role of these multiple actors more explicit. "States conscript, contract and facilitate private activity in the service of (environmental) regulation in various different ways" (Bennett 2000, p. 882), including mandating disclosure, providing information, or requiring auditing of practices. The recent shift towards third-party development of

standards does not take the state out of the process, only changes its role. Giovannucci and Ponte (2005) see this as a new form of social contract where the state provides the overall framework for standards while NGOs and firms together define the specifics. As Eden points out, “unlike government, governance cannot discipline directly and must rather continually negotiate, rather than impose, their influence” (Eden 2009, p. 392). The work that standards do is therefore continually negotiated, defined, challenged, updated, and practiced. Others agree that states still have the potential for the strongest influence over the production process, not third parties, so that the changes wrought by standards are not as deep or long-lasting as those which are directly regulated (Rohracher 2009).

At the same time, a distinct feature of the current trend is “the emergence of domestic and transnational private governance systems that derive their policy-making authority not from the state, but from the manipulation of global markets and attention to customer preferences” (Cashore 2002, p.503-504). In other words, the difference from existing regulation is the source of the demand for the governance. Such non-state market-driven systems have to establish their own legitimacy through the certification process, promoting their self-interest as well as those of producers seeking their label. Because of this focus on consumer demand, such systems run the risk of being coopted by neoliberal interests who promote consumers over citizens, or of furthering the paradox in using consumer-based standards to achieve sustainable development (Brown and Getz 2008, Higgins et al. 2008, Klooster 2010). Additionally, producers or retailers may comply in the interest of occupying a new market niche rather than a sincere desire to reduce environmental or social impacts (Hatanaka and Busch 2008). Even attempts to

go beyond what state governments have regulated, such as influencing labor practices (Nadvi 2008) or the fair treatment of farmworkers (Brown and Getz 2008), tend to benefit farmers and factory owners more than workers.

Standards are purposefully flexible, relying on expert judgment in the field, which can be a source of strength in adapting to local conditions (Eden 2008). However, this interpretation can become obscured behind the logo or certificate that is presented at the end of the certification process, the "black box" that hides the effort that went into producing a product as sustainable or fair trade or organic. Knowing not only how standards came to be but how they are implemented and interpreted in the field is key to judging their effectiveness (Eden 2009). As with traditional government regulation, the same questions of who participates and whose interests are being represented are still present (Hatanaka and Busch 2008, Konefal and Hatanaka 2011). Since the goal of many rating systems is to transform the marketplace and/or production methods, there is a necessary balance to be struck between making a material difference in the world by reducing negative impacts to a measurable extent, and keeping standards simple and achievable enough that they will be adopted.

A building is a much more complicated product than a cup of coffee or a piece of lumber. In particular, the knowledge and practices involved in designing, constructing, and inhabiting a building are complex and multi-faceted. The rating systems that have been developed to certify buildings as green or sustainable nevertheless follow many of the same characteristics as forestry or agro-food certification schemes. As these systems are accepted and implemented in more places, the question arises of how and where knowledge about green buildings is

produced and/or mobilized. The next section describes the importance of this spatial perspective to urban sustainable development.

ECONOMIC GEOGRAPHIES OF ARCHITECTS AND ARCHITECTURE

Architectural firms have been of interest to economic geographers in particular because of their role as a cultural industry, and also because they embody the local/global dialectic that drives many of today's economic processes. Like many industries, architecture firms cluster in specific locations due to agglomeration effects: sharing a labor pool, sharing ideas and tacit knowledge, and competing and cooperating at the same time (Amin and Cohendet 2004, Faulconbridge 2006). But architecture has a special role as a cultural or creative industry with potential for economic growth in the knowledge economy. One such cluster of firms is in the Netherlands, where "superdutch" firms attract interns and junior architects from around the world who hope to learn from "starchitects" like Rem Koolhaas on the way to establishing their own practices (Kloosterman 2008). Work in this area has teased apart the "local buzz" feature of agglomeration economies (Bathelt et al. 2004, Bathelt and Turi 2011) and shown that it is not so much direct interactions between firms that sustain the cluster, but a highly-mobile labor pool that circulates ideas and information as junior staff move from firm to firm or even to their own spinoff firms (Kloosterman 2008, 2010).

The local/global dialectic is very much on display with architecture firms, who may have projects around the world at any given time. The question remains of how a profession which is so grounded in local context can be global at the same time. One approach is to rely on iconic buildings that position a city or institution as being part of the network of world cities (Charney

2007b, Kaïka 2010), although even this requires striking a balance between external uniqueness and internal familiarity and functionality (McNeill 2007). Another is to install local offices on a temporary basis or to contract with local professionals as the architect of record; they have knowledge of building codes and regulations as well as how to get things done in terms of interacting with regulatory officials and labor (May and Wood 2003, Faulconbridge 2009). Learning and innovation also happen in more places and more ways than simply where an architectural firm's offices are located: objects such as models and press accounts travel and enable learning about new techniques or designs, while architects themselves travel and observe their surroundings (Faulconbridge 2010). At the same time, even global firms may not have much interaction among their branches, so tracing the actual interactions of individuals and ideas is key to understanding the geographies of architectural practice.

There is more to understanding architecture as economic production than architectural firms, however (Knox 1987). For example, property developers also play a significant role (Charney 2005, 2007a). Politics and prestige are also important, given the strong visual impact of iconic buildings and their potential to reshape the skyline (Charney 2007b, Tavernor 2007). Iconic architecture may take on a deeper role in moments of crisis, allowing existing institutions and elites to retain and reshape their power by producing a new identity or reinventing themselves. For example, London's City was marked by traditional, iconic structures like St. Paul's Cathedral, but the need for the Corporation that regulates the City to reinvent itself and keep from losing importance relative to other neighborhoods and world cities led to the acceptance of new, tall structures that take on the dual role of transnational branding and speculative development

(Kaïka 2010). Green buildings may increasingly contribute to the cultural significance of architecture as emblems of environmental concern and action, as evidenced by visually provocative buildings such as Seattle's Central Library that prominently include green elements (Figure 1). Therefore, understanding if and how the firms that produce these buildings cluster is important to understanding how urban sustainability is produced (Allen and Potiowsky 2008).

This geography of architectural production has contributed to the understanding of how and why firms locate where they do, and what difference it makes to what these firms produce. However, the focus has been almost exclusively on large, global firms, and on large, iconic structures. Less is known about the geographies of production of smaller, mundane buildings like a community library or an ordinary apartment building, or about architects in non-global firms (Faulconbridge 2010). The current paper moves towards filling that gap by considering the spatial distribution of the firms involved in producing certified green buildings for a selection of U.S. cities in order to determine the extent to which knowledge of how to design and/or build green buildings has to travel.

INTRODUCTION TO LEED AND METHODS USED

LEED is one of a growing number of environmental certification rating systems that provide a benchmark and a common language among participants from multiple arenas. In this case, LEED is the dominant rating system in the U.S. for green buildings, defined as structures with a lower environmental impact than a standard building. Under the standards developed by the non-profit U.S. Green Building Council (USGBC), this relational definition is broken down into a series of credits covering elements such as water and energy conservation, light pollution and

habitat disruption, access to public transportation, and environmental disruption during construction. While a few credits are mandatory, most are electives, up to the building owner and designer to decide how many and which ones to obtain. Certification is achieved at one of four levels: Certified, Silver, Gold, and Platinum. The first three levels are each achieved about 30 percent of the time, with Platinum at about 10 percent of the total. Certification is achieved not through onsite inspection, but through documentation submitted to the USGBC.

For this project, data were obtained directly from the USGBC listing all LEED-certified buildings in the U.S. by location as of December 2010, approximately 6,000 in total for those categories where a new building is being constructed (the USGBC also certifies commercial interiors and the operation and maintenance of existing buildings). Of these certified buildings, about 16 percent were listed as "confidential", where the building owner chose not to make the building's name and address public; those could not be included in the analysis. Eight metropolitan regions were chosen for study: Albuquerque, Atlanta, San Francisco-Oakland-San Jose, Chicago, Dallas-Ft. Worth, Grand Rapids, MI, Minneapolis-St. Paul, and Philadelphia. This wide range of cities includes broad geographic representation and variation in terms of population. Table 1 lists the total population and number of non-confidential green buildings in each metropolitan area, along with the number of architects and general contractors who were successfully identified.

City	***Metro area population***	***LEED-certified buildings***	***Architects identified***	***Contractors identified***

Albuquerque, NM	0.9 million	29	29 (100%)	28 (97%)
Atlanta, GA	5.3 million	62	56 (90%)	62 (100%)
Chicago, IL	9.5 million	112	91 (81%)	94 (84%)
Dallas-Ft. Worth, TX	6.4 million	56	44 (79%)	40 (71%)
Grand Rapids, MI	0.8 million	80	73 (91%)	73 (91%)
Minneapolis-St. Paul, MN	3.3 million	42	35 (83%)	36 (86%)
Philadelphia, PA	6.0 million	61	55 (90%)	42 (69%)
*excluding PNC Bank branches		47	47 (100%)	34 (72%)
San Francisco-Oakland-San Jose, CA	7.5 million	84	81 (96%)	80 (95%)
Total Without PNC Bank		526 512	468 (89%) 456 (89%)	455 (87%) 447 (87%)

Table 1. Cities chosen for study and architects and contractors identified. Note: since many of the Philadelphia-area buildings were branches of PNC Bank, certified in bulk from a single architect, the analysis was done with and without those buildings.

Identification of architecture and general contracting firms took place through a web search of the building's name, paired with "contractor" or "architect" if necessary. Projects were frequently listed on firms' websites as case studies or demonstrations of past work; sometimes municipalities or local USGBC chapters highlighted buildings; and sometimes news articles provided the needed information. The success rate at identifying the relevant firms for most cities was high (Table 1). If there were multiple architects listed, the architect of record was included, since they are the firm most likely to have been involved in the details of making the design fit LEED requirements, rather than a more conceptual design.

For each firm, two locations were recorded: their headquarters (if an international firm, their U.S. headquarters), and if they had multiple branches, the closest branch to the building in question, whether in the same metropolitan area or at some distance. This is not a perfect measure of where the buildings were actually designed or managed; for example, Turner Construction has an office specifically devoted to green building activity in Sacramento, CA, meaning that projects around the country may be managed from Sacramento regardless of whether there is a local office. Nevertheless, the presence of a local office indicates at least some input from local employees in the design and construction process, particularly regarding local physical and regulatory climates and characteristics as well as permitting procedures. For general contractors, this is certainly true via a presence on the construction site. Maps showing the location of the largest firms in design, green design, contracting, and green contracting in 2010 are described below as background to the findings on the spatial distribution of architects and contractors involved in producing green buildings.

FINDINGS

What is the spatial distribution of firms producing green buildings? – The analysis began with data from Mc-Graw Hill, a private firm that collects data on the construction industry and has recently included sustainable architecture and contracting firms (where sustainability is defined as third-party-certified activity). The spatial distribution of the top one hundred firms based on revenue engaged in design activity, green design, general contractors, and green contractors is shown in Figure 2. As the maps show, there is some difference between regular and green firms. For design, green firms are more broadly spatially distributed, beyond major cities on the coasts and in smaller, interior cities such as Des Moines, Indianapolis, and Cincinnati. Perhaps surprisingly given their green reputations, Portland and San Francisco have proportionately fewer green design firms than regular design firms, and Dallas and Washington, DC, have more. For general contractors, a similar pattern seems to hold but to a lesser extent. Michigan and the Mid-Atlantic have more green firms while the far Southwest has fewer, with a few outliers such as Billings, MT, and Albuquerque, NM. Albuquerque in particular was chosen for this project based on these maps as a site of strong local green design and contracting activity.

How local are the firms producing green buildings? – Given that the data from McGraw-Hill indicated a relatively low spatial concentration for green architecture firms, one would expect to find that most buildings were designed locally, and that was the case (Table 2). Of the 471 buildings for which an architect could be identified, around 80% had a local office, and about 66% were headquartered locally.

City	*Total green buildings with data*	*Total architecture firms*	*Projects per firm*	*Projects with a local office*	*Projects with a local HQ*
Albuquerque, NM	30	18	1.67	27 (90%)	26 (87%)
Atlanta, GA	56	35	1.6	49 (88%)	38 (68%)
Chicago, IL	91	60	1.52	84 (92%)	68 (75%)
Dallas-Ft. Worth, TX	44	28	1.57	39 (89%)	27 (61%)
Grand Rapids, MI	73	29	2.51	60 (82%)	56 (77%)
Minneapolis-St. Paul, MN	35	23	1.52	31 (89%)	28 (80%)
Philadelphia, PA	61	55	1.34	32 (58%)	31 (56%)
*excluding PNC Bank branches	47	40	1.18	32 (68%)	31 (66%)
San Francisco-Oakland-San Jose, CA	81	59	1.42	77 (92%)	59 (70%)
Total	471	289	1.63	372 (79%)	307 (65%)

Without PNC	457	274	1.67	372 (81%)	307 (67%)

Table 2. Locality of architects involved in green building projects by metropolitan area. Data source: USGBC and various websites.

The "projects per firm" column indicates the extent to which there was repeat business for the same set of firms within a region. For example, for the three largest metropolitan areas in terms of the numbers of green buildings, San Francisco and Chicago averaged around one and a half projects per firm, but Grand Rapids averaged two and a half. Overall, Grand Rapids was significantly above average in this respect, indicating that there are relatively few architecture firms in this city working on green buildings (which makes sense given its relatively small population). The overall figure of over one and a half projects per firm indicates that in most cities, architects are putting to use their LEED skills on more than one structure, suggesting a diffusion of green practices beyond an initial project. At the same time, since most cities had dozens of certified green buildings, the same figure of one and a half projects per firm suggests that within a metropolitan area, it is not a few architecture and contracting firms who are becoming green building experts, but that dozens of firms are learning the necessary skills[2].

For nearly all cities, between 80% and 90% of green building projects had a local office. Philadelphia was a clear low outlier, even when removing the centrally-designed branch offices of Pennsylvania-based PNC Bank. As a relatively low-growth city compared to others on the

[2] In fact, the original intent of this project was to conduct a social network analysis of firms involved in green building in different metropolitan areas, but there were so few repeat combinations of architecture and contracting firms from building to building that there was no network to be analyzed.

East Coast, this suggests that building owners in Philadelphia draw on architects from other cities to design their buildings. However, for all of the cities studied, many architectural firms have a local presence but are not headquartered locally, since the average drops to around 66% when considering whether or not the location of a firms' headquarters is within the metropolitan area. For smaller cities like Albuquerque, Grand Rapids, and Minneapolis-St. Paul, the percentage of locally headquartered firms remains high, indicating that in these smaller markets, buildings are more likely to be designed by locally-based architecture firms, not branch offices. Atlanta, Chicago, Dallas, and the Bay Area had between 30-40% of their projects designed by firms headquartered outside the region, even if most of these firms had a local presence. This is still well less than half, suggesting that the globalization of architectural firms is not an accurate portrayal of the economic geography behind the average building. It also suggests that knowledge of how to design to meet LEED standards is spreading across the country, not that firms located in clusters of green building activity are learning local conditions in order to design for distant buildings.

City	***Total green buildings with data***	***Total contracting firms***	***Projects per firm***	***Projects with a local office***	***Projects with a local HQ***
Albuquerque, NM	27	17	1.65	24 (86%)	24 (86%)
Atlanta, GA	62	34	1.85	60 (95%)	38 (60%)

Chicago, IL	94	48	1.96	89 (95%)	76 (81%)
Dallas-Ft. Worth, TX	38	21	1.81	33 (87%)	23 (61%)
Grand Rapids, MI	73	20	3.65	67 (92%)	59 (81%)
Minneapolis-St. Paul, MN	36	22	1.64	35 (97%)	33 (92%)
Philadelphia, PA	42	25	1.68	34 (81%)	31 (74%)
*excluding PNC bank branches	34	24	1.42	26 (76%)	23 (68%)
San Francisco-Oakland-San Jose, CA	77	46	1.67	75 (97%)	59 (77%)
Total (with PNC)	449	233	1.93	415 (92%)	342 (76%)
Without PNC	441	232	1.90	407 (92%)	334 (76%)

Table 3. Locality of contractors involved in green building projects by metropolitan area. Data source: USGBC and various websites.

The local effect was even more pronounced for general contractors. Of the 449 buildings for which the contractor was identified, 92% of the time, the contractor had an office in that same metropolitan area (Table 3). This is not surprising, given the need to monitor day-to-day

operations onsite during construction, but it does indicate the wide spread of knowledge about how to build a LEED-certified building. Values ranged from a high of 97% for Minneapolis-St. Paul and the Bay Area to a low of 76% for Philadelphia (excluding PNC Bank branches). The number of projects per firm was generally a little higher than the same figure for architects, although Grand Rapids' average of 3.65 projects per firm again makes it a considerable outlier. This indicates even more strongly that firms have been able to put to use the knowledge they have gained about how to build a LEED-certified building on more than one structure.

As for whether general contracting firms were headquartered locally or were a branch of a regional or national organization, 76% of green building projects were contracted to a firm with its headquarters in the same metropolitan area (compared to around 66% for architects). The high was 92% in Minneapolis-St. Paul and the low was 61% in Atlanta and Dallas, a wider range than for architectural firms. It is not surprising that Atlanta and Dallas would have many of their structures built by firms with a local branch but distant headquarters given that their most rapid growth has been in the post-war period. Albuquerque was the only city to have no local branches of national firms, perhaps because it is a relatively small city that is not commonly seen as a site for inward investment.

As mentioned above, several of the credits involved in obtaining LEED certification are related to construction practices, such as reducing construction waste and developing construction indoor air quality management plans. Furthermore, since LEED certification is awarded not through an onsite inspection but through the submission of documentation and paperwork, keeping track of the procedures and practices as the building is being constructed is

fundamental. Having contractors who are knowledgeable about LEED can therefore be extremely important in achieving certification. The findings here indicate that while there are some large contracting firms who have a specialty in green building, like Turner Construction and Skanska, the predominant spatial pattern is local firms learning how to meet LEED requirements rather than multinational firms learning local environmental and regulatory conditions. With 92% of green building projects being constructed by a firm with a local office and 76% by a firm with local headquarters, there is strong evidence for the broad spatial distribution of green building construction techniques across regions and in differently-sized cities.

CONCLUSIONS

The question of how different kinds of knowledge travel or are constructed in different places is key to the increasing emphasis on greening the economy. While certain producer services such as construction or architecture have always had to pay attention to local conditions, this becomes doubly important when trying to meet a set of standards defining the greenness of a building in a specific local context. Understanding the regional physical environment, regulatory conditions at multiple scales, and the local built environment requires knowledge of local conditions that must then be combined with the codified knowledge in the form of the LEED rating system (which itself is flexible and open to interpretation in the field (Eden 2008, 2009)). Before asking how these different knowledges flow through space and time and intersect with one another, it is important to know the extent to which the flow of each might be necessary.

Through this study of the location of firms involved in green building activity in a selection of U.S. metropolitan areas, this paper finds that the overwhelming majority of these firms have an office in the city where they are designing and/or constructing these buildings, and that the majority are also headquartered in these cities. This suggests that most firms already have the necessary knowledge of local conditions to produce a green building because they are located in the city or region in which they are building. Granted, simply having an office in a city does not automatically make workers in that office familiar with local conditions, nor does *not* having an office there mean that a firm is unfamiliar with the local environment (Faulconbridge 2010). Follow-up research should therefore include contacting the firms involved in green building activity for more details, including tracing the paths of individual careers within these firms (Vinodrai 2006) for a subset of the over 500 buildings analyzed here. Nevertheless, the findings here indicate that rather than green building activity clustering in cities with a "green" reputation like Portland, OR (Allen and Potiowsky 2008), there is a strong case to be made that it is happening in cities of different sizes, growth rates, and regions of the country, spreading the economic development benefits of the green economy over a wide area.

Within this sample of cities, the smaller ones tended to have an even higher percentage of locally-headquartered firms than average. In these cities, there are less likely to be iconic structures for which national searches would be held; building are more likely to be fire stations, schools, or mixed-use development. In contrast, larger cities like Chicago or San Francisco, despite having high concentrations of architecture firms, were more likely than smaller cities to have their buildings designed by firms located or headquartered elsewhere

(although that still occurred less than half of the time), perhaps because of the need to have an iconic structure (Kaïka 2010). This suggests that economic geographies of architecture would benefit from considering mundane structures in addition to iconic ones in order to fully understand the geography of the industry.

If building to the third-party specifications of the LEED rating system requires combining two types of knowledge—the codified knowledge of the standards and the multi-scalar knowledge of physical and regulatory conditions—this research indicates that it is the former that is traveling rather than the later. This is encouraging for organizations like the USGBC who are trying to spread their rating system as widely as possible and for others who are trying to generally raise awareness about building more sustainably. Furthermore, to the extent that architects and contractors are benefitting economically from the spread of third-party standards, most of that benefit is staying within the metropolitan area in which buildings are being built, not transferred to a distant corporate headquarters. This is a clear indication that the green economy is expanding in a wide variety of places, not only those which are known for having a green or sustainable reputation. Further research should investigate the mechanisms by which the codified knowledge of LEED is transferred between places (beginning with the USGBC itself and its "education" programs), the extent to which relationships between architects and contractors help to increase green building activity within regions, and the role of municipal and state governments' mandates of green building certification in shaping this portion of the green economy.

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